T01D04 - Nomenclature: Ionic Compounds

Name KEY

Ionic compounds are formed when a metal loses electrons, and a non-metal gains those electrons. Compounds are generally electrically neutral which means that the electrons lost by the metal are gained by the non-metal. No excess or deficiency or electrons can exist. There are several types of ionic compounds. The first type called Type I consists of a metal that can have only one valence or oxidation number and a non-metal from the periodic table. The metals in Group IA, IIA, IIIA, and a few of the transition elements such as scandium, yttrium and silver fall into this category. When the metals lose electrons they are called **cations** and have charges of +1, +2 or +3. The non-metals will gain a set number of electrons those in Group 15 (nitrogen family) will gain three electrons to become -3; Group 16 (Oxygen family) will gain two electrons to become -2; Group 17 (Fluorine family) will gain one electron to become -1. The other numbers you see over their symbols (Groups 15,16 and 17) are because they can form a number of covalent or molecular compounds and polyatomic ions. Non-metals are given the general name **anions.** All of these are binary compounds.

Type I:

Write the formulas for the following binary ionic compounds.

	S^{2-}	Cl^{-}	N^{3-}	O^{2-}	C^{4-}
Ba^{2+}	BaS	$BaCl_2$	Ba_3N_2	BaO	Ba_2C
Sc^{3+}	ScS	$ScCl_3$	ScN	Sc_2O_3	Sc_4C_3
Na^{+}	Na_2S	NaCl	Na_3N	Na_2O	Na_4C
Al^{3+}	Al_2S_3	$AlCl_3$	AlN	Al_2O_3	Al_4C_3
Mg^{2+}	MgS	$MgCl_2$	Mg_3N_2	MgO	Mg_2C
Ag^{+}	Ag_2S	AgCl	Ag_3N	Ag_2O	Ag_4C

These compounds are named by having the metal ion retain its original name, and the non-metal changing its ending to ide. The first one above would be barium sulfide, and then barium chloride. Name the remaining ones underneath their formulas

BaS

*always metal then nonmetal.

barium sulfide

(metal stays the same) (non-metal takes -ide ending)

Ba_3N_2

barium nitride

(no prefixes)

Type II Ionic compounds are those having a metal that has a variable valence, and one of the non-metals we used above. The elements with variable valences are generally in the transition group of elements along with lead and tin, and a few other elements. The formulas are done the same way as above but the naming is slightly different. In the name of the compound we must include the charge of the cation.

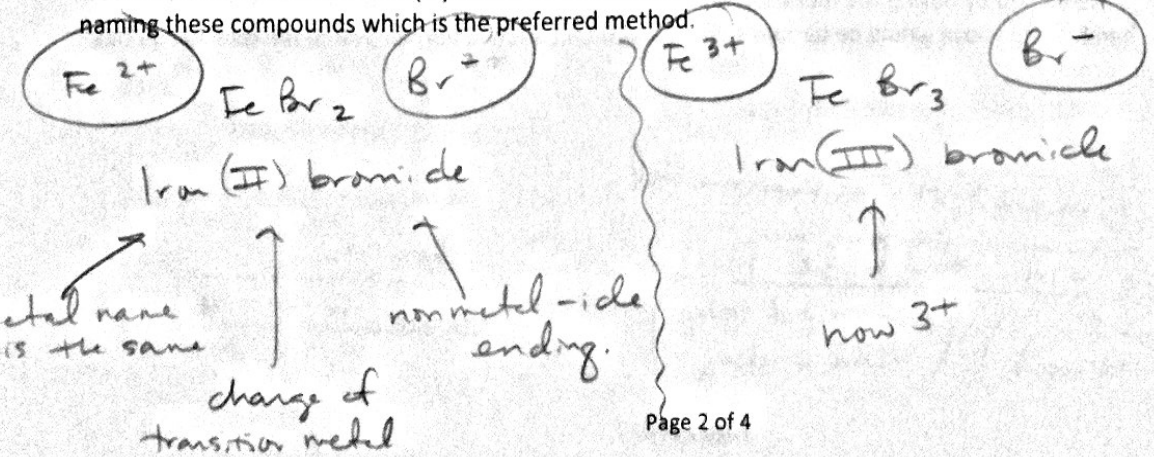
***You must use the charge of each ion and polyatomic to complete.

Complete the following table for Type II ionic compounds.

	Br^-	P^{3-}	S^{2-}	O^{2-}	Cl^-
Fe^{+2}	$FeBr_2$	Fe_3P_2	FeS	FeO	$FeCl_2$
Co^{+3}	$CoBr_3$	CoP	Co_2S_3	Co_2O_3	$CoCl_3$
Ni^{+3}	$NiBr_3$	NiP	Ni_2S_3	Ni_2O_3	$NiCl_3$
Fe^{+3}	$FeBr_3$	FeP	Fe_2S_3	Fe_2O_3	$FeCl_3$
Au^{+3}	$AuBr_3$	AuP	Au_2S_3	Au_2O_3	$AuCl_3$
Pb^{+4}	$PbBr_4$	Pb_3P_4	PbS_2	PbO_2	$PbCl_4$

When naming these compounds I have to include the charge of the metal ion. For example, the first one above is called iron (II) bromide, the second iron (II) phosphide. Only roman numerals are used, and the number applies to the charge on the metal ion, and not how many cations or anions are in the compound. Write the name of the remaining compounds underneath their formulas.

There is an older way of naming these compounds that is still in existence. We will not be using it but it is still common, and in use. The lower valence or oxidation number of the metal will end in **ous** and the higher oxidation state will end in **ic**. The first one above would be called ferrous bromide instead of iron (II) bromide and the second one would be ferrous phosphide instead of iron (II) phosphide. Ferrous is used instead of iron because it is its older name from which its symbol is derived. Most of the transition series would be easier. Cobalt (II) would be cobaltous and cobalt (III) would be cobaltic, and so forth. We will stick the roman numeral method of naming these compounds which is the preferred method.



Type III ionic compunds are those having have a metal ion (Type I or II), and a polyatomic ion (sometimes referred to as an oxyanion). Writing the formulas is just as above except that when multiple units of the polyatomic ion appear in the compound I have to include parenthesis around the ion.

Complete the following table of Type III ionic compounds. ***You must use the charge of each ion and polyatomic to complete.

	SO_4^{2-}	PO_4^{3-}	$S_2O_3^{2-}$	OH^-	CO_3^{2-}
Ba^{2+}	$BaSO_4$	$Ba_3(PO_4)_2$	BaS_2O_3	$Ba(OH)_2$	$BaCO_3$
Fe^{+3}	$Fe_2(SO_4)_3$	$FePO_4$	$Fe_2(S_2O_3)_3$	$Fe(OH)_2$	$Fe_2(CO_3)_3$
Na^+	Na_2SO_4	Na_3PO_4	$Na_2S_2O_3$	$NaOH$	Na_2CO_3
Al^{3+}	$Al_2(SO_4)_3$	$AlPO_4$	$Al_2(S_2O_3)_3$	$Al(OH)_3$	$Al_2(CO_3)_3$
Pb^{+2}	$PbSO_4$	$Pb_3(PO_4)_2$	PbS_2O_3	$Pb(OH)_2$	$PbCO_3$
Ag^+	Ag_2SO_4	Ag_3PO_4	$Ag_2S_2O_3$	$AgOH$	Ag_2CO_3

Naming these compounds is just you have done in the previous two exercises. The first one is called barium sulfate, and the second one is barium phosphate. Now name the remaining underneath their formulas. REMEMBER if the metal has a variable valence I must include a roman numeral in its name.

This is all there is to writing formulas for and naming ionic compounds.

$BaSO_4$

barium sulfate

barium ↑ metal stays the same

sulfate ↑ Polyatomic stays the same.

$Fe_2(S_2O_3)_3$

Iron (III) thiosulfate

Iron ↑ metal

(III) ↑ 3+ charge

thiosulfate ↑ Polyatomic